Claims:

Our claims are the following:

1. A method of processing a multi-dimensional signal with arbitrarily shaped domain via a multi-scale transform comprising the steps of:
    a. Obtaining the multi-dimensional signal
    b. Performing a domain adaptive transform on the signal

2. A method of processing all or a portion of a multi-dimensional signal with a domain composed of a collection of arbitrarily shaped domains via a multi-scale transform comprising the steps of:
    a. Obtaining a multi-dimensional digital image frame
    b. Breaking the image frame into constituent arbitrary shaped domains, or given such a set, that cover all or a portion of the original multi-dimensional signal domain.
    c. Performing a domain adaptive transform on one or more of the collection of arbitrary shaped domains

3. The method of encoding all or a portion of a multi-dimensional signal with an arbitrarily shaped domain or all or a portion of a multi-dimensional signal via a multi-scale transform comprising the steps of:
    a. Obtaining the multi-dimensional signal
    b. Performing the domain adaptive transform on the signal
    c. Quantizing the resultant decomposition coefficients
    d. Encoding and transmitting the quantized values over an information channel to a decoder for reconstruction of an approximated signal.

4. A method of processing all or a portion of a multi-dimensional signal with a domain composed of a collection of arbitrarily shaped domains via a multi-scale transform comprising the steps of:
    a. Obtaining a multi-dimensional digital image frame
    b. Breaking the image frame into constituent arbitrary shaped domains, or given such a set, that cover all or a portion of the original multi-dimensional signal domain.
    c. Performing the domain adaptive transform

d. Quantizing the resultant decomposition coefficients

e. Encoding and transmitting the quantized values over an information channel to a decoder for reconstruction of an approximated signal.

5. A method of processing a multi-dimensional signal via multi-scale transform comprising the steps of:

a. Obtaining the multi-dimensional signal

b. Performing a pattern adaptive transform on the signal

6. The method of claim 2 where step b comprises of a combined domain and pattern adaptive transform.

7. The method of claim 3 where step b comprises of a combined domain and pattern adaptive transform.

8. The method of claim 4 where step c comprises of a combined domain and patern adaptive transform.

9. The method as in any one of claims 3, 5, or 6 where instead of transmitting over an information channel the encoded data is placed onto a storage apparatus or mechanism for the purpose of efficient storage and later decoding.

10. The method as in any one of claims 3, 5, or 6 where instead of directly quantizing the resultant decomposition coefficients and then encoding, the coefficients are passed through a bit-plane encoder.

11. The method as in any one of claims 1 or 5 where the multi-dimensional signal is comprised of multiple color or intensity components.

12. The method of claim 11 where the signal is 2-D and there are three color components and these represent Y, U, and V.

13. The method of claim 11 where the signal is 2-D and there are three color components and these represent R, G, and B.

14. The method of claim 11 where the signal is 2-D and there are three color components and these are any orthogonal color components.

15. The method as in any one of claims 2 or 6 where the multi-dimensional image frame is a still image frame.

16. The method as in any one of claims 2 or 6 where the multi-dimensional image frame is an intra-frame for a sequence of video images.

17. The method as in any one of claims 2 or 6 where the multi-dimensional image frame is a residue frame for a sequence of video images.

18. The method as in any one of claims 1 or 6 where the domain adaptive transform is applied during the calculation of coarser scale representations in the forward transform of a multi-scale transform.

19. The method as in any one of claims 1 or 6 where the domain adaptive transform is applied during the estimation of next finer scale representations in the inverse transform of a multi-scale transform during the reconstruction phase either in conjunction with or irrespective of the use of the method in claim 18.

20. The method as in any one of claims 1 or 6 where the domain adaptive transform is applied in order to construct a sub-band decomposition of a multi-scale transform.

21. The method as in any one of claims 18, 19, or 20 where instead of the domain adaptive transform, the pattern adaptive transform is used.

22. The method of claim 20 where instead of the domain adaptive transform, a combined pattern and domain adaptive transform is used.

23. The method as in any one of claims 1 or 6 where the domain adaptive transform is applied during the estimation of the next finer level of sub-bands in a multi-scale transform during the reconstruction phase.

24. The methods of claims 19 or 23 where the domain adaptive transform is applied either with or without the presence of quantization or bit-plane pruning.

25. The method as in any one of claims 1 or 6 where the domain adaptive transform is applied such that the points external to the arbitrary domain but within the support of the filter (or filters) are excluded from the mathematical result of the convolution or weighted average / difference.

26. The method as in any one of claims 1 or 6 where the domain adaptive transform is applied such that the points external to the arbitrary domain but within the support of the filter (or filters) are included in the mathematical result of the convolution or weighted average / difference but are further multiplied (or re-weighted) by another set of weighting factors.

27. The method of claim 26 where the set of additional multiplicative factors is determined as the result of calculation of a local measure characterizing the transition at the boundary of the arbitrary domain.

28. The method of claim 27 where the measure is based on a statistical function of the pixel value differences across the boundary transition.

29. The method of claim 28 where the statistical function is the mean.

30. The method of claim 28 where the statistical function is the median.

31. The method of claim 28 where the statistical function is based on a weighted average.

32. The method of claim 28 where the statistical function is based on a weighted average with coefficients that are nonlinear functions of the data values themselves

33. The method of claim 28 where the statistical function is a pre-determined constant

34. The method of claim 26 where the set of additional multiplicative factors is determined as the result of calculation of a local measure characterizing the transition at the boundary of the arbitrary domain and the calculation of the local measure is dependent on data which is available to the decoder at the time of the operation when envisioned as part of the inverse transform or reconstruction phase of a multi-scale transform.

35. The method of claim 34 where the calculation of the local measure is based on one or more coarser scales of representation of the signal which have already been decoded and thus made known to the decoder by the time of the inverse transform step.

36. The method of claim 34 where the calculation of the local measure is based on a motion compensated model frame (or equivalent) that has already been decoded and thus made known to the decoder by the time of the inverse transform step in the context of a encoder-decoder system related to the efficient transmission or storage of a sequence of video data.

37. The method as in any one of claims 25 or 26 where the needed function for renormalization, i.e. replacement of the missing filter coefficients, is

accomplished by a statistical function of the remaining pixel values which are located at points contained within the arbitrary shaped domain.

38. The method of claim 37 where the statistical function is based on the median.

39. The method of claim 37 where the statistical function is a mean.

40. The method of claim 37 where the statistical function is a weighted average.

41. The method of claim 40 where the statistical function is a weighted average with coefficients that are nonlinear functions of the data values themselves.

42. The method of claim 37 where some form of outlier rejection is used to ensure that outliers remaining inside the intersection of the domain and the filter support do not disrupt the local accuracy or efficiency of the transform.